

### **ABSTRACT OF THE DISCLOSURE**

A compositionally-graded, strain relaxed  $\text{Si}_{1-x}\text{Ge}_x$  ( $0 < x < 1$ ) material having a surface roughness of less than 1 nm. In a preferred aspect, the compositionally-graded material is  $\text{Si}_{1-x}\text{Ge}_x$  ( $0 < x < 0.3$ ) material having a threading dislocation density  $< 1 \times 10^5$  defects/cm<sup>2</sup> of surface area. The compositionally-graded material is readily formed by vapor deposition or other suitable technique, in which the temperature is selectively modulated during the growth process, optionally with modulation of germanium precursor flow rate, to produce a low surface roughness, low threading dislocation defect density graded silicon-germanium film suitable for forming strained heterostructures such as  $\text{Si}_{1-x}\text{Ge}_x/\text{Si}$ .